

Application of PRA Technologies Risk Advisory System



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Introduction – Risk Advisory Systems

- **Provides ability to examine in real-time the impact on a plant's risk from:**
 - past operating practices,
 - current plant conditions, and
 - future planned activities.
- **Also Known as Risk or Safety Monitors (RM or SM).**
- **Based on plant's current as-built, operated, and maintained configuration.**
- **Underlying logic model is based on and updated with the plant's Living PRA.**
- **Uses familiar terminology/nomenclature and an easy-to-use interface to make the PRA model and insights available to non-PRA analysts.**



History of RASs

- **Development of Technology began in early 1980's**
- **First true RAS was installed at Heysham NPP Unit 2 in 1987.**
- **Two commercially available RASs were developed and began to be installed at U.S. plants in the mid-1990s.**
- **At present, RASs are installed at over 100 plant sites in at least 8 countries**
- **US NRC recently licensed a RAS for training its inspectors in PRA technologies.**



PRA Applications – Initial PRAs

- **Initial PRAs**
 - are usually Level-1, internal-events, full-power PRAs (i.e., of limited scope),
 - often use specific modeling approaches/simplifications for early quantification,
 - documentation often does not easily relate plant design and operation to modeling assumptions,
 - provide insights regarding plant safety, but
 - generally are not suitable for PRA Applications



PRA Application – Conditions

- **To Be Used in PRA Applications a PRA Model Must:**
 - reflect current conditions at the plant.
 - use an appropriate modeling approach.
 - have an appropriate scope.
 - have a proper pedigree



PRA Applications – Conditions Continued

- **Modeling Approach**
 - **Software Capabilities**
 - **Intended Use**
- **Pedigree**
 - **Use of QA program during model development**
 - **Reviews (QA, Peer, Regulatory)**



PRA Applications – Conditions Continued

- **Scope**
 - Level
 - Initiating Events
 - Plant Operating Mode
 - Sources
- **Current Conditions (Living PRA)**
 - Documented
 - Updateable



DOE Sponsored RAS Activities

- **DOE Sponsored RAS Activities at two NPPs**
 - **Dukovany NPP**
 - Plant provided PRA model
 - Plant provided license for RAS (Safety Monitor)
 - DOE sponsored implementation of PRA model in RAS
 - **Bohunice NPP**
 - Plant provided PRA model
 - DOE provided license for RAS (R&R Workstation EOOS Module)
 - Plant sponsored implementation of PRA model in RAS.



Implementation at Bohunice & Dukovany

- **Plant staff dedicated to PRA efforts.**
- **PRA maintained by third-party TSO**
- **Initially RAS will be used to examine past events/practices.**
- **Plans for incorporating RAS insights into:**
 - **Maintenance Scheduling, and**
 - **Allowed Outage Times.**
- **Model and software shared with regulator.**
- **Neither Plant intends near-term use for on-line monitoring of risk.**



Lessons Learned at Bohunice & Dukovany

- **Two sets of PRA models required at both plants**
 - **Software – RAS model unquantifiable by the PRA Software.**
 - **Modeling considerations – RAS must reflect actual conditions, not an average (e.g., maintenance activities must be modeled differently).**
- **Mapping of PRA terms to more familiar terminology was a significant activity at both plants.**
- **Required model changes are coordinated between the TSO and plant staff as changes are made to plant configuration, operation, and maintenance activities. To our knowledge, neither plant has a dedicated configuration management program.**



RAS Software Comparison (Similarities)

- **Both Software Packages (Safety Monitor and EOOS) have similar features. Major feature differences are expected to become smaller as new version are introduced.**
- **Both support other language interfaces and data input (though Cyrillic hasn't been demonstrated on Safety Monitor).**
- **Both support import and use of PRA models that are built and maintained in other PRA modeling software.**



RAS Software Comparison (Differences)

- **EOOS – Open Applications Program Interface.**
 - Functions available to other programs.
 - Features/Interface can be modified/added by local programmers.
 - Completely Customizable.
 - QA of code must be done locally
- **Safety Monitor**
 - Code is closely controlled and QA by vendor.
 - Features are modified/added by vendor.
 - Consistent interface and feature set at every implementation.



Summary

- **RASs are excellent tools for using PRA based information in operations, maintenance, and training activities.**
- **Implementation of a RAS based on an Initial PRA is a significant undertaking.**
- **A Living PRA of appropriate scope and pedigree should be established prior to pursuing any PRA Application.**
- **Implementation of a RAS should not be used to drive a PRA into Living PRA of proper scope and pedigree.**